THE ANNALS

AND

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[FOURTH SERIES.]

"..... per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

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I.—*On the Organization of Sponges, and their Relationship to the Corals.* By Ernst Häckel*.

The class of Sponges has hitherto stood, in many respects, isolated in the world of organisms. No other class of the animal or vegetable kingdom, containing an equal number of abundant, large, and multifarious forms, has left naturalists, even up to the most recent times, so much in doubt as to its true nature, or called forth such a number of contradictory opinions. Whilst most of the older naturalists regarded the Sponges as plants, and most of the modern ones considered them to be animals, the intermediate opinion also made itself felt from time to time—namely, that from the indifferency of the characters of their organization, and from their mixture of animal and vegetable peculiarities, they were to be assigned to that remarkable group of the lowest and simplest organisms, which (in my 'General Morphology of Organisms') I have placed as the kingdom of the Protista, between the animal and vegetable kingdoms. Without entering here upon an historical exposition of the numerous different opinions which have ever been entertained by naturalists as to the position of the Sponges in the classification of organisms, the opposite stand-points of the most esteemed naturalists may nevertheless be briefly indicated.

* From the 'Jenaische Zeitschrift,' Band v. pp. 207–254; translated by W. S. Dallas, F.L.S.

Placing at the head of them, as is customary, the name of Aristotle, even this "father of natural history" was quite in doubt as to the nature of the sponges; for while, in many passages, he describes the sponges known to him as animals, he regards them in another place as plants, and in a third refers them to those indifferent organisms which constitute the gradual and imperceptible transition from the animal to the plant.

Linné, who regarded all the sponges known to him as species of a single genus, *Spongia*, placed them, in 1735 (in his 'Systema Naturæ'), at the end of the vegetable kingdom, below the lowest Cryptogamia, combining them with the corals and coralliform Bryozoa as Lithophyta. Even in the tenth edition of his 'Systema Naturæ' (1760) this view is maintained. But in the twelfth edition (1767) he adopts the views of Ellis and Pallas, who had in the meanwhile declared the sponges to be animals, and placed them with the corals, among the Zoophyta.

Of those naturalists who even subsequently regarded the sponges as plants, Spallanzani, Sprengel, and Oken are especially to be noted; and this opinion has been held, even up to the most recent period, by Burmeister and Ehrenberg. Nevertheless the sponges have pretty generally passed as *animals* since Grant, in 1826, thoroughly described the canal-system of the sponges with its "pores" and "oscula," and also ascertained their reproduction by means of ciliated free-swimming larvæ.

With regard to the position occupied by the sponges in the system of animals, two different views especially stand at present in opposition to one another, and have done so for more than twenty years. In conjunction with Cuvier, most zoologists regarded the sponges as the nearest allies of the corals or polypes, and referred them, with these, to the primary division of the Radiata. The determining motive for this position was not, however, the recognition of the actual agreement of the sponges and corals in their most essential characters of organization, but rather the external similarity which exists between many sponges and corals in outward habit, and especially in the mode of stock-formation. But when, about a quarter of a century ago, it began to be perceived that the so-called "Radiate type" was a confusedly mixed assemblage of very various lower animals, and when, afterwards, as the recognition of their differences of organization advanced, the Radiata were divided into the three quite different main groups of the Echinodermata, Cœlenterata, and Protozoa, the sponges were not left with the corals or Anthozoa among the Cœlen-

terata, but degraded into the lowest section of the animal kingdom—a particular place being assigned to them, with the Infusoria and Rhizopoda, among the Protozoa.

The accurate investigations of the minute organization of the sponges which have been made since 1848, with improved microscopic appliances, and in accordance with the requirements of modern anatomy, appeared at first to fix this last position afresh. The very careful anatomical investigations of Carter in the East Indies (from 1848) and of Lieberkühn in Berlin (from 1856) seemed concordantly to lead to the result that the sponges were true Protozoa, and possessed close relations of affinity, on the one hand, to the Rhizopoda, and especially to the Amœbæ, and, on the other, to the true Infusoria (Ciliata) and to the Flagellata. In particular the structure of the parts of the siliceous skeleton of the siliceous sponges was compared to that of the similar and often scarcely distinguishable siliceous formations of the Sphærozoa and other Radiolaria. Moreover certain isolated sponge-cells were not to be distinguished from Amœbæ. The isolated ciliary cells from the canal-system of the sponges, which bear only one long whip-like cilium, resembled the individual Flagellata. Whilst thus the relationships of the sponges to the other Protozoa were sought in various directions, on the other hand the characteristic canal-system of the sponge-body could not but appear as a higher organic contrivance, which was entirely wanting in the other Protozoa, or at the utmost admitted of a very distant physiological comparison with the contractile vesicle of the Infusoria and Amœbæ. Hence, in proportion as more extended investigations revealed the multifarious modifications of this canal-system in the various groups of sponges, the opinion became more and more general that this was a quite peculiar vascular apparatus, and that the whole class of sponges was in consequence to be regarded as a class of animals *sui generis*, which stood in no near relations of affinity to any other class, either among the Protozoa or among the Cœlenterata.

This opinon, which is now predominant, that the peculiar canal-system of the sponges represents a perfectly specific nutritive apparatus, such as occurs in no other animals, and that, consequently, the Spongiæ are to be regarded as a peculiar and isolated class of animals *sui generis*, was expressed even by Grant (1826) and Johnston (1842), and has been maintained in recent times, especially by those zoologists who have gained most credit for the classification of sponges, namely, Oscar Schmidt and Bowerbank. The further the systematic investigations of the latter extended, and the more

the minute structure of the sponges has been made known of late by the researches of Lieberkühn and Kölliker, the more did this isolated position of the class of sponges with its specific "water-vascular system" appear to be established.

In opposition to this predominant conception, only a few naturalists have of late adhered to the older opinion, that the Spongiæ were of all animals most nearly allied to the corals. Among these few Leuckart is especially to be noted. In 1854 he directly asserted the relationship of the sponges and polypes (corals) in the following words:—"If we imagine a polype-colony with imperfectly separated individuals, without tentacles, stomachal sac, and internal septa, we have in fact the image of a sponge with its large 'water-canals' opening outwardly." Leuckart accordingly placed the sponges in the system with the corals, in the natural primary group of the Cœlenterata, the typical arrangement of the organization of which he had been the first to recognize, in 1848, in their gastrovascular apparatus, the "cœlenteric canal-system." He did not, however, either then or afterwards, adduce any further proof of the near relationship of the sponges and corals, or demonstrate in detail the homologies actually existing between the two classes.

When I was staying, for three months, in the winter of 1866-67, upon the Canarian island of Lanzarote, I induced my travelling companion and pupil, M. Miklucho-Maclay, of St. Petersburg, to investigate thoroughly the extraordinarily rich sponge-fauna which we met with upon the lava-blocks of Puerto del Arrecife, the harbour of the island. The most important result of these spongiological investigations, of the correctness of which I have repeatedly convinced myself by my own observations, was the fact that the sponges stand in a much nearer relationship to the corals than has been previously admitted, and even than Leuckart had supposed. In particular, it appeared, from Miklucho's investigations, that the "perfectly peculiar" canal-system of the sponge-body was by no means such a peculiarly specific arrangement, but rather equivalent in general, both in form and function, to the gastrovascular system or cœlenteric apparatus of the Cœlenterata, and especially of the corals; in fact that this "nutritive system" is both homologous and analogous in the two classes. I was able the more impartially to recognize this highly important fact, by which the true affinity of the Spongiæ and Cœlenterata is definitively established, because previously, following the prevailing opinion, and supported particularly upon the views of Lieberkühn and Oscar Schmidt, I had regarded the sponges as peculiar Protozoa, most nearly allied to

the Rhizopoda, and had placed them, in my 'General Morphology,' in the indifferent kingdom of the Protista.

Miklucho has published the most important results of his researches in his "Beiträge zur Kenntniss der Spongien," which appeared in 1868 in the fourth volume of the 'Jenaische Zeitschrift' (pp. 221–240, pls. 4 & 5). They relate chiefly to the remarkable *Guancha blanca*, a small calcareous sponge, which is to be reckoned one of the most interesting forms of the whole animal kingdom; for it forms small stocks (*cormi*), the constituent individuals (*persons*) of which belong, according to their structure, to different genera, and even different families, of the Calcispongiæ, and nevertheless grow forth from one and the same root.

Miklucho's remarkable observations on *Guancha blanca*, of the accuracy of which I constantly convinced myself with my own eyes while in Lanzarote, induced me last winter to submit to a comparative examination the numerous small calcareous sponges which I had previously collected in the North Sea at Heligoland, and in the Mediterranean at Nice, Naples, and Messina. Subsequently I also found some interesting small calcareous sponges on stones, univalve shells, and algæ, which I had collected, during my return journey from the Canary Islands, on the north-west coast of Africa, near Mogador, and in the Straits of Gibraltar, near Algeçiras, and brought with me well preserved in spirits. To this rich material of my own was added the calcareous sponges of the Zoological Museums of Edinburgh, Berlin, Munich, and Hamburg, which MM. Allman, Peters, Von Siebold, and Bolau were kind enough to send me. Through M. Schmeltz, I obtained from the Godeffroy Museum a number of interesting Australian calcareous sponges from Bass's Straits. My honoured friend and colleague, Professor Oscar Schmidt of Gratz, was good enough to send me specimens of the greater part of the calcareous sponges collected by him in the Adriatic. How abundant was the material thus placed at my command may be best learnt from the fact that I have been able to distinguish no fewer than 42 genera and 132 species among the Calcispongiæ.

I shall give exact descriptions and figures of these calcareous sponges, increased by a number of new forms which I expect to have sent to me by various colleagues, in the special part of my monograph of the Calcispongiæ, now in course of preparation. In the general part of this monograph I shall give a detailed exposition of the general natural history of the Calcispongiæ, which, I hope, will advance not only the knowledge of this little group, but in many respects that of the sponges in general. For although the legion of the Calcispongiæ is

one of the smallest legions of the class of sponges, and, moreover, for the major part, contains exceptionally small, nay, even microscopic forms, it is nevertheless capable, more than all other sponges, of throwing a valuable general light upon the conditions of organization and affinity of the whole class. Moreover the special systematic and morphological relations of this small order are so simple and clear, and the genealogical relationships of its different genera and species so instructive and interesting, that a thorough elucidation of them is of great importance even to the general classification of organisms.

As the most important result of my investigations, I start with the following general proposition :—The sponges are most nearly allied to the corals of all organisms. Certain sponges differ from certain corals only by a less degree of histological differentiation, and especially by the want of urticating organs. The most essential peculiarity of the organization of sponges is their nutritive canal-system, which is both homologous with and analogous to the so-called cœlenteric vascular system, or gastrovascular apparatus of the Cœlenterata. In the sponges, just as in the corals, and, indeed, in the Cœlenterata generally, all the different parts of the body originate by differentiation from two primitive simple formative membranes or germ-lamellæ, the entoderm and the ectoderm. These two lamellæ originate by differentiation from the originally homogeneous cells which (having been produced by the segmentation of the ovum) compose the spherical body of the ciliated embryo or of the primitive larva (*Planula*). From the inner or vegetative germ-lamella, the entoderm, originate the nutritive epithelium of the canal-system and the reproductive organs. From the outer or animal germ-lamella, the ectoderm, all the other parts originate.

Before I proceed to support this proposition by a brief statement of the results of my observations, I may be permitted to make a few remarks upon the position which, in accordance with it, the sponges will henceforward have to occupy in the system of the animal kingdom, beside or below the Cœlenterata. For as we must infer, from the general homology which exists between all parts of the sponge- and coral-organisms, not merely an apparent anatomical agreement, but an actual blood-relationship of the two classes of animals, the question forces itself upon us, with respect to the system, what particular place the sponges will have to take in the existing classification of the Cœlenterata.

In recent zoological systems the stem or type of the Cœlenterata is pretty generally divided into three classes :—1. Corals (Polypes or Anthozoa) ; 2. Hydromedusæ (Hydroida and

Medusæ); 3. Ctenophora (Ciliograda). All the animals of these three classes agree not only in the characteristic formation of the nutritive vascular system, but also in the possession of urticating organs, for which reason Huxley grouped them together as Nematophora. These characteristic urticating organs are entirely deficient in all true sponges. The absolute *deficiency of the urticating organs in all sponges*, and their constant presence in all corals, Hydromedusæ, and Ctenophora, is at present the *sole morphological character* which sharply and decidedly separates the first class from the last three. I have therefore, in my 'Monograph of the Monera,' and subsequently in my 'Natural History of Creation,' included the three last-mentioned classes under the old name of *Acalephæ* or *Cnidæ* (nettle-animals). Even Aristotle comprehended under this denomination the two characteristic primary types of the group, the free-swimming *Medusæ* and the sedentary *Actiniæ*. Moreover the distinctive character of the nettle-animals, namely the possession of urticating organs, is just as clearly expressed by this denomination as by Huxley's name Nematophora.

We should therefore have to divide the stem or phylum of the Zoophytes (*Cœlenterata* s. *Zoophyta*) into two primary groups (subphyla or cladi)—1, Sponges (*Spongiæ* s. *Porifera*), and, 2, Nettle-animals (*Acalephæ*, s. *Cnidæ*, s. *Nematophora*). The latter would divide into the three classes of the Corals, Hydromedusæ, and Ctenophora. Among the sponges we might *provisionally* distinguish as two classes the *Autospongiæ* and the fossil *Petrospongiæ*, as hitherto these two groups have not allowed themselves to be brought into near connexion either in the whole or in detail. Among the Autospongiæ the *Calcispongiæ* would form a distinct subclass or legion.

We might perhaps go even further, and, supported by the very near relations of affinity of the sponges and corals, speak in favour of the following division of the Cœlenterata :—

Cladus I. Bush-animals (Thamnoda).

Class 1. Sponges (*Spongiæ*).
Class 2. Corals (*Corallia*).

Cladus II. Sea-jellies (Medusæ).

Class 1. Umbrella-jellies (*Hydromedusæ*).
Class 2. Comb-jellies (*Ctenophoræ*).

Time only can decide which grouping best corresponds to the natural relationships, when the genealogy of the

Cœlenterata can be more completely established upon the basis of extended ontogenetic and comparative anatomical investigations.

That the essential agreement in the internal organization of the sponges and corals, their actual homology, has hitherto been for the most part overlooked is due, among other things, to the fact that the most accurate anatomical investigations of recent times (especially those of Lieberkühn) took their start from the two best-known and commonest forms of sponges—namely, the freshwater sponge (*Spongilla*), which belongs to the group of the true siliceous sponges, and the common sponge (*Euspongia*), belonging to the group of horny sponges. But these very two forms of sponges differ in many respects considerably from the original and typical structure of the entire class, have been in many ways modified and retromorphosed by adaptation to special conditions of existence, and therefore easily lead to erroneous conceptions, especially as their investigation is comparatively difficult.

On the other hand, among all the sponges, no group appears better fitted to shed full light upon the typical organization and the true relations of affinity of the whole class than the legion of the Calcispongiæ. Lieberkühn has already expressly acknowledged this in his 'Beiträge zur Anatomie der Kalkspongien' (1865), and endeavoured, from the results obtained from the Calcispongiæ, to render the other sponges more intelligible.

This applies in the first instance even to the *individuality* of the Calcispongiæ, which is adapted, in a far higher degree than that of most other sponges, to elucidate the difficult tectology or theory of individuality of the sponges. Reserving the circumstantial statement of these conditions, which are equally interesting and important, for my monograph of the Calcispongiæ, I will here cite only the result of my special investigations upon this point. This consists essentially (leaving out of consideration some modifications) in a confirmation of the opinion quite recently put forward by O. Schmidt, that every part of the sponge-body which possesses an excurrent orifice (*osculum*) is to be regarded as a distinct "individual." This "true individual" of the sponge-body I denominate, in accordance with my theory of individuality, a "person;" and every sponge-body that consists of two or more persons (*i. e.* that possesses two or more oscula) I denominate a "stock" or "cormus." The special limitation of these two ideas, which are rendered necessary by the peculiar conditions of individuality of the sponges, I reserve for my monograph. There are consequently simple (solitary or monozoic) and compound

(social or polyzoic) sponges. Of simple sponges or persons we have examples in *Sycum* and *Ute* among the calcareous sponges, *Caminus* among the bark sponges, and *Euplectella* among the siliceous sponges. On the other hand, *Leucosolenia* and *Nardoa* among the calcareous sponges, *Euspongia* among the horny sponges, and *Spongilla* among the siliceous forms are compound sponges or stocks.

I do not, like most other authors, regard the characteristic canal-system of the sponges as something quite specific and peculiar to this class, an arrangement *sui generis*, but share in the opinion of Leuckart and Miklucho, that it is essentially *homologous with the cœlenteric vascular system* or gastrovascular apparatus of the corals and Hydromedusæ—in fact, of all the Acalephæ or nettle-animals. Indeed I am so thoroughly convinced of this homology that I (with Miklucho) designate the largest cavity into which that canal-system is dilated in the sponge-body, and which is usually called the excurrent tube or flue (*caminus*), as the *stomach*, or digestive cavity, and its outer orifice, which is usually called the excurrent orifice or osculum, as the buccal orifice or mouth.

In opposition to this conception two objections especially will be urged—namely, in the first place, that there are sponges with no flue and osculum, and, secondly, that the direction of the flow of water in the sponge-body is not reconcilable with it. As regards the first objection, I think I can invalidate it by a simple reference to developmental history. The sponges without flue and without osculum are either primitive sponge-forms, whose ancestors had never attained to the differentiation of this central part of the canal-system, or they are retromorphosed forms whose ancestors have lost stomach and mouth by phyletic degeneration. The latter stand in the same relation to the more highly developed sponges furnished with mouth and stomach as the Cestode worms to the Trematoda. The Cestoda (in consequence of their stronger adaptation to the parasitic mode of life) have also lost the intestine and mouth, which their trematodiform ancestors possessed. Most of the mouthless sponges, such, especially, as the *Clistosyca* and *Cophosyca* among the Calcispongiæ, are probably to be regarded as such retromorphosed, and not as originally astomatous forms; and if their embryos, which are still unknown to us, actually acquire a mouth and stomach like the other sponge-embryos, this ontogenetic fact would most decidedly confirm our phylogenetic hypothesis. *Sycocystis*, the young form of which is provided with a mouth, while the mature form is astomatous, may even now be cited in its favour.

The *physiological conditions of the water-circulation in the*

sponge-body seem to constitute a more substantial objection to our interpretation. It is well known that generally (but not always!) the direction of the flow of the water which passes through the canal-system of the living sponge-body is as follows:—The water flows in through very numerous and fine *cuticular pores* (the so-called "incurrent apertures"), usually perceptible only by means of the microscope, and through these fine "incurrent canals," which often ramify and anastomose repeatedly, reaches a few larger canals, which finally open into the central "excurrent cavity" (our "stomachal cavity"). From this the used water then escapes outwards with the useless solid particles through the "excurrent orifice" (our "mouth").

In the corals or Anthozoa, on the other hand, as also in the other Cnidæ, the direction of the flow of the water which traverses the cavities of the body appears to be different, and in a certain sense opposed to the ordinary direction of the current in the sponges. The water, which at the same time conveys the food into the body, is usually, in the Cnidæ and, especially, in the corals, taken up by the mouth, passes through this into the stomach, and hence into the other canals which traverse the body. The part played in this process by the cutaneous pores of the corals is unfortunately still as good as unknown. These fine apertures in the skin, usually perceptible only through the microscope, through which the finest canals of the cœlenteric vascular system open outwards in the corals, just as in the sponges, have by no means attracted so much attention in the former as in the latter. Nay, they have scarcely even been compared! Whilst the greatest importance has been attached to the cutaneous pores of the sponges, those of the corals, although long known, have been almost universally ignored; and yet the two are evidently *homologous*, and of one and the same origin! Nay, it is even very possible (not to say probable) that through the skin of the corals, as through that of the sponges, respiratory currents of water constantly penetrate into the body by means of the cutaneous pores, and that these traverse the canals of the body-wall, and finally discharge themselves into the stomachal cavity. The cutaneous pores in the corals might then, just as much as in the sponges, be designated "incurrent apertures."

So much, at any rate, is certain, that an essential *morphological* difference does *not* exist between the nutrient vascular system of the sponges and corals. If we compare single, solitary, perfectly developed persons of the two classes, *e. g.* *Sycum* and *Actinia*, we find in both a central cavity as the true principal part of the nutrient canal-system—a central cavity

(flue or stomach) which opens outwards by a single large orifice (osculum or mouth). From this cavity canals issue in all directions, which traverse the body-wall, and finally open on their surface by the cutaneous pores. If, on the other hand, we compare a sponge-stock (e. g. *Sycodendrum*, *Spongilla*) and a coral-stock (e. g. *Dendrophyllia*, *Gorgonia*), we find in like manner, in both, a nutrient canal-system of the cœnenchyma or cœnosoma, which places the cavities of the individual persons in communication with each other.

The difference in the direction of the current of water which is usually admitted in the two classes is a matter of perfect indifference in this close *morphological* comparison. Even if this difference was really constant, general, and thoroughgoing, it would not be capable of invalidating our notion of the homology of the canal-system in the body of the sponge and coral. The difference in the circulation of the nutrient stream of water in the two classes of animals would merely prove that no *physiological* comparison, no *analogy*, exists between the individual parts of the vascular system, but that this has rather been lost by *adaptation* to different conditions of nutrition. But by this our *morphological* comparison of the corresponding parts, their *homology*, which we must ascribe to inheritance from common ancestors, is in no way affected. But when we have to grasp the true relation of affinity of two groups of animals, we must consider only their actual homologies, *i. e.* those similarities arising from common inheritance, which alone constitute the true guiding-star in every comparative exposition. On the other hand, we must leave entirely out of consideration the *analogies* which depend upon mere *adaptation*, because these are much better fitted to obscure and conceal than to illuminate and clear up this relation of affinity.

But it must be pointed out that this contrast in the direction of the current of water, which is almost universally assumed to occur in the vascular system of the sponges and corals, and regarded as without exception, is by no means an absolute and unfailing one. Miklucho has already shown that in a great many sponges the mouth or osculum by no means permits only the outflow, but also the inflow of water. I have repeatedly convinced myself, by my own observations, of the correctness of this assertion. Consequently the mouth in many sponges, just as in the corals, serves for both the reception and expulsion of the water and the nutritive constituents contained in it.

For the right understanding of these relations, those sponges which have no cutaneous pores at all, and in which the sole

aperture of the perfectly simple stomachal cavity is the oseulum or mouth, are of peculiar importance. Such a *sponge without cutaneous pores*, and the entire cœlenteric canal-system of which consists, as in *Hydra*, of a perfectly simple stomachal cavity with a simple mouth-orifice, was believed by Miklucho to be presented in his *Guancha blanca*. I have, however, by subsequent careful examination of the forms of *Guancha* collected by Miklucho himself and handed over to me, ascertained that this sponge possesses simple cutaneous pores. On the other hand, I have examined two microscopically small, but yet perfectly developed (*i. e.* ovigerous), calcareous sponges collected by me in Naples, in which there are actually no traces of cutaneous pores. The entire body of these most primitive forms of Calcispongiæ consists of an elongate rounded sac (stomach), with a single opening (mouth) on that extremity of the body which is opposite to the point of attachment. For this extremely interesting primitive form, which must evidently open the series of the Calcispongiæ, I propose the name of *Prosycum*.

But full light is thrown upon these, as upon all other organic relations, only by *developmental history*. The earliest young forms of the sponges, the ciliated embryos, which afterwards swarm about freely as larvæ by means of their ciliary coat, diffuse this light in the most desirable manner. I have traced the ontogeny of these youngest forms (which were previously known among the Calcispongiæ only in *Sycum* and *Dunstervillia*) in a number of quite distinct genera, and have by this means arrived at the following results, which in part confirm, and in part essentially enlarge, the existing observations on the ontogeny of the sponges.

After the egg has been broken up, in consequence of the process of segmentation, into a spherical, mulberry-like aggregation of closely adpressed, homogeneous, naked spherical cells, the mulberry-like embryo, by stronger growth in one direction, acquires an ellipsoidal or oval form, and covers its surface with cilia. A small central cavity (stomach) is then produced in its interior; this extends, and, breaking through at one pole of the longitudinal axis, acquires an aperture, the mouth.

Either before the buccal orifice of the stomach is perforated, or at any rate soon afterwards, the free-swimming, ciliated larva of the calcareous sponges sinks to the bottom of the sea and attaches itself there. The point of adhesion is usually situated at the pole of the longitudinal axis which is opposite to the mouth (aboral pole). The body of the young sponge now forms a simple, elongate rounded, adherent sac, the cavity

of which communicates with the surrounding sea-water only by a single aperture, the mouth, placed opposite to the point of attachment. *In this early young state*, when it constitutes a simple cup-shaped body with solid walls and a simple aperture, *the young sponge is not essentially different from a young coral* which is still in the same early period of ontogenesis. But just as the common freshwater Polype (*Hydra*) presents persistently throughout life, in its simple sac-like body-cavity, a similar cœlenteric primitive state to that which all corals pass through in their youth, so does this just-mentioned simplest calcareous sponge (*Prosycum*) remain throughout its life, until perfect maturity, in the same cœlenteric primitive state which the other calcareous sponges have to pass through rapidly in their earliest youth. Considering, now, that extremely important and intimate *causal connexion* which everywhere exists between *ontogeny* and *phylogeny*,—considering the morphogenetic fundamental law, that the *ontogeny* (that is to say, the individual developmental history of the organism) constitutes a short and rapid (causally conditioned by the laws of inheritance and adaptation) repetition of its *phylogeny*, that is, of the palæontological developmental history of the ancestors of its entire stock,—considering this high phylogenetic signification of all ontogenetic states, we must, from these simple facts, from this ontogenetic concordance between the young states of the sponges and corals, draw the extremely important phylogenetic conclusion, that *the sponges and corals are near blood-relations*, whose origin is derived from one and the same original common stock-form. This unknown stock-form, of whose special structure no fossil remains are preserved to us from the archolithic period of the earth's history, but as to whose former existence we may conclude with perfect certainty from the adduced facts, nay, of whose general form we have even still an approximate picture in *Prosycum simplicissimum*!, must have possessed a simple cup-shaped body, with a single orifice placed opposite to its point of attachment. We will give this the name of the primitive sac, Protascus. From this hypothetical *Protascus* probably originated, as two divergent branchlets, *Prosycum* (the stock-form of the Calcispongiæ) and *Procorallum* (the stock-form of the corals).

[To be continued.]

II.—*On the Species of the Genus* Philhydrus *found in the Atlantic Islands.* By D. Sharp, M.B.

When engaged last spring in making an examination of our British *Philhydri*, and comparing them with the few speci-